

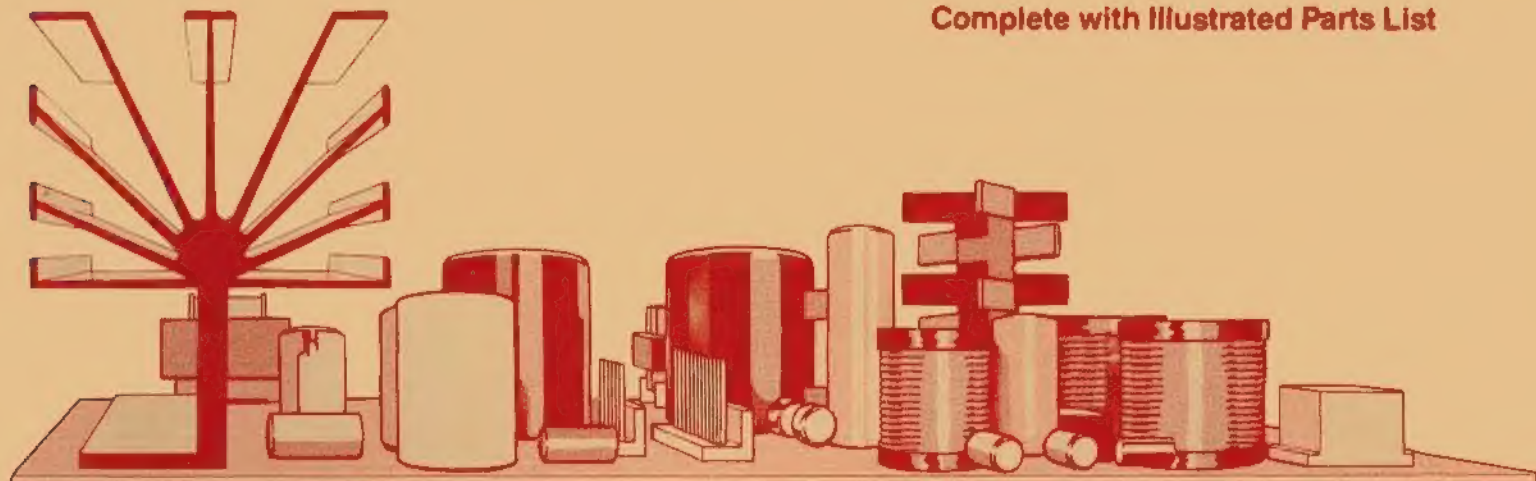


# Switching Power Supply

A038074-07 and -17

## Service Manual

Complete with Illustrated Parts List



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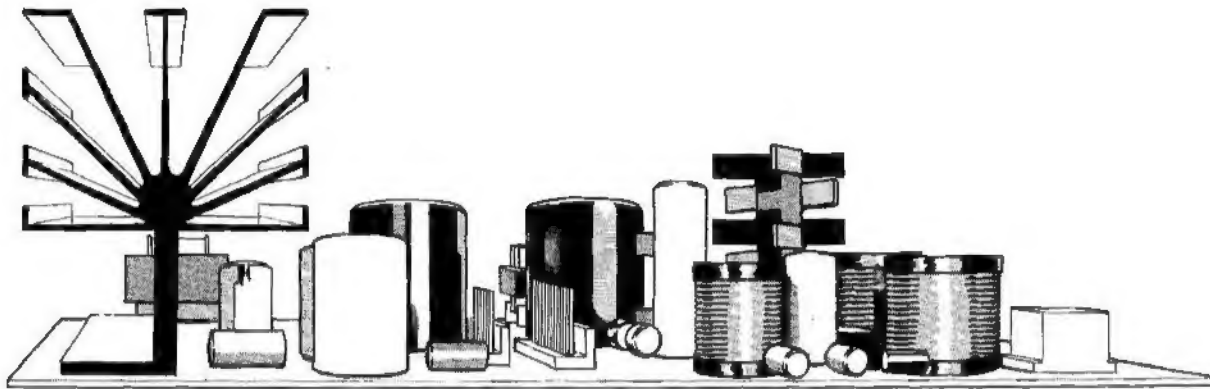
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# **Switching Power Supply**

**A038074-07  
and -17**

## **Service Manual**

**Complete with Illustrated Parts List**



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## TABLE OF CONTENTS

|   |  |    |
|---|--|----|
| 1 | WARNINGS AND CAUTIONS                                    |    |
|   | Before You Start.....                                    | 1  |
|   | Safety Measures.....                                     | 1  |
|   | Replace with Proper Components.....                      | 2  |
|   | Final Testing Before Reinstalling Power Supply.....      | 2  |
| 2 | SPECIFICATIONS   |    |
|   | Mechanical.....  | 3  |
|   | Environmental.....                                       | 3  |
|   | Electrical.....  | 3  |
| 3 | DETAILS OF OPERATION                                     |    |
|   | General Description.....                                 | 6  |
|   | Circuit Description.....                                 | 6  |
| 4 | TROUBLESHOOTING  |    |
|   | Troubleshooting Aids.....                                | 12 |
|   | Precautions.....   | 12 |
|   | Circuit Description.....                                 | 12 |
|   | Assembly and Component Locations.....                    | 13 |
|   | Schematic Diagram.....                                   | 13 |
|   | Performance Specifications.....                          | 13 |
| 5 | ILLUSTRATED PARTS LIST                                   |    |
|   | Switching Power Supply PCB Assembly Parts List.....      | 16 |
| 6 | SCHEMATIC DIAGRAMS                                       |    |
|   | Switching Power Supply Schematic Diagram, 038074-07..... | 24 |
|   | Audio Amplifier Schematic Diagram, 038074-07.....        | 26 |

## LIST OF ILLUSTRATIONS

|          |   |    |
|----------|---|----|
| Figure 1 | Block Diagram.....                                    | 7  |
| Figure 2 | Switching Power Supply PCB Assembly, A038074-07.....  | 15 |
| Figure 3 | Switching Power Supply Schematic Diagram, 038074-07.. | 24 |
| Figure 4 | Audio Amplifier Schematic Diagram, 038074-07.....     | 26 |

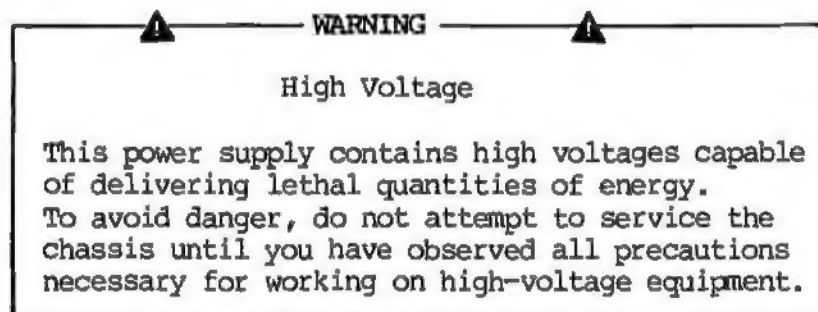
## 1 WARNINGS AND CAUTIONS

This switching power supply is designed to mount inside the game cabinet and is electrically connected to the game circuitry through several multi-pin connectors.

### Before You Start

Never attempt to work on this power supply until you are familiar with servicing precautions and procedures necessary for high-voltage equipment. Never modify any circuit in this power supply.

Perform servicing on this power supply only after you are thoroughly familiar with the following warnings and safety measures. Also, refer to Chapter 4 for precautions related to troubleshooting.



### Safety Measures

Good safety habits will allow you to take the proper precautions automatically, even if you are rushed. Whenever you work on this power supply, ground it first. Also, use only one hand. This avoids the possibility of carelessly putting one hand on the chassis or ground and the other on an electrical connection. Doing so could cause a severe electrical shock. Also, make sure all ground points are connected. To prevent fire or shock hazard, never expose this power supply to moisture.

Use extra precaution in the high-voltage circuitry areas of the power supply. If a short circuit occurs, replace any components that indicate they may have overheated.

### Replace with Proper Components

Maintain the specified values of all components within the power supply. Failure to do so could cause damage or improper operation. Refer to the parts lists in Chapter 5 of this manual for a detailed description and values for the component parts of the power supply.

For continued product safety, use only exact replacement parts, especially for those parts identified in the parts lists with the (!) symbol and on the schematic diagrams with shading.

### Final Testing Before Reinstalling Power Supply

Before reinstalling this power supply into the game, inspect all harness wiring to the power supply. Make sure no wires or cables are pinched between the cabinet and other parts in the power supply.



## 2 SPECIFICATIONS

for -07 (U.S. line voltages) and -17 (European line voltages) Versions

### NOTE

-07 10 A, 5 V output, 2-Channel Audio (Stereo) Power Supply for Raster Display. Components associated with +31.5 V are not inserted.

-17 10 A, 5 V output, 2-Channel Audio (Stereo) Power Supply for Raster Display. Components are inserted for 220 V input. Components associated with +31.5 V are not inserted.

### Mechanical

#### Vibration

The power supply will withstand a vibration input of 0.5 G with a logarithmic sweep rate of 1 octave/minute for 30 minutes, and a vibration input of 0.5 G at 30 Hz for 30 minutes without affecting the mechanical and electrical performance.

### Environmental

#### Temperature

##### Operating

0° to +50° C (+32° to +122° F)

##### Storage

-40° to +70° C (-40° to +158° F)

#### Humidity

##### Operating/Storage

10 to 90%, relative; no condensation

##### Overload Protection

All outputs are protected against overload (including a short).

### Electrical

#### Line Voltage

(Selectable) 102 to 132 VAC and 200 to 264 VAC

|                           |  |
|---------------------------|--|
| Line Frequency            | 47 to 63 Hz  |
| Output Voltages           | <p>A. +5 V <math>\pm 0.5\%</math>, 10 A with force and sense lines terminated at the power supply.</p> <p>B. -31.5 V <math>\pm 3\%</math>, 1.0 A (3 A total using the audio amplifiers)</p> <p>C. +145 V <math>\pm 3\%</math>, 0.75 A, or 200 V <math>\pm 3\%</math>, 0.4 A (selectable)</p> <p>D. +15.5 V <math>\pm 3\%</math>, 1.4 A</p> <p>E. Audio: 10 W RMS into 8 Ohm, 40 Hz to 10 kHz <math>\pm 3</math> dB (each channel).</p> |
| Regulation                |  |
| Line                      | With the maximum current and input voltage as specified the output will vary no more than $\pm 0.5\%$ (+5 V Output), $\pm 1\%$ (Outputs B through D).  |
| Load                      | <p><math>\pm 0.5\%</math> or less (+5 V Output), <math>\pm 5\%</math> or less (Outputs B through D) with loads varied in any combination over the following range:</p> <p>A. +5 V: 1.6 to 8 A</p> <p>B. -31.5 V: 0.2 to 1.0 A</p> <p>C. +145 V: 0.1 to 0.75 A</p> <p>D. +15.5 V: 0.25 to 1.4 A</p> <p>E. 120 VAC: 0 to 0.7 A RMS</p> <p>F. Audio Output: 0 to 10 W (each channel)</p>  |
| Temperature Stability     | $\pm 0.1\%$ /C maximum over the range 0° to +50° C (+32° to 122° F) for all outputs.   |
| Ripple and Spike Voltage* | 2% p-p or less.  |
| Output Hold-Up Time       | 16 msec minimum at full power and at 120 VAC.  |
| Overcurrent Protection    | 180% maximum of the maximum input current (normal maximum input current is the input current of the supply under the fully loaded condition).  |

|                        |  |
|------------------------|--|
| Overvoltage Protection | 6.5 V $\pm$ 0.5 V at +5 V output.  |
| Remote Sensing         | +5 V output has a remote sense for both the output and the return. The sense line has runaway protection where, if either or both sense lines are open, the output will not change more than $\pm$ 5%. |

\*This does not include the very short spike at the positive and negative peaks of the triangular (ripple) waveform.

### 3 DETAILS OF OPERATION

#### NOTE

Refer to the switching power supply block diagram in Figure 1 to aid in understanding the following details of operation.

#### General Description

The ATARI switching power supply uses switching transistors to change a rectified and filtered line voltage to a 25-kilohertz pulse train. The switching transistors are turned on to their saturated state which minimizes power loss. An inductance-capacitance (LC) network filters the output of the power transformer to the average rather than the peak output voltage. Consequently, the output voltage is controlled by varying the width of the pulses applied to the power transformer. This pulse-width modulation technique eliminates the voltage drop that occurs across the regulator in a linear-type power supply. The power supply also includes differential-input operational amplifiers to amplify the game sounds.

#### Circuit Description

Line Filter and Rectifier. The line-filter and rectifier stage provides the direct current (DC) input to switching transistors Q1 and Q2. The line filter network L1, C1, C3, and C4 limits the noise transferred from the supply to the line and helps protect the supply from line noise.

When using a 120-volt alternating current (AC) line input, a jumper is added so that bridge rectifier BR1 and capacitors C6 and C7 form a voltage-doubler circuit. When using a 220-volt AC line input, with the jumper removed, BR1 becomes a full-wave rectifier. Thus, the DC voltage to the power transistors is the same for both 120- and 220-volt AC line inputs. The center connection between C6 and C7 also provides a 120-volt AC source for some low-power circuits when a 220-volt AC line input is used. This configuration eliminates the need for special parts for transformer T1, the fan, and the fluorescent lights when using European line voltages.

Power Driver. The power driver stage converts the DC voltage from the line filter and rectifier stage to a 25-kilohertz pulse train. Switching transistors Q1 and Q2 are power metal-oxide semiconductor field-effect transistor (MOSFET) which require about +10 volt between the gate and the

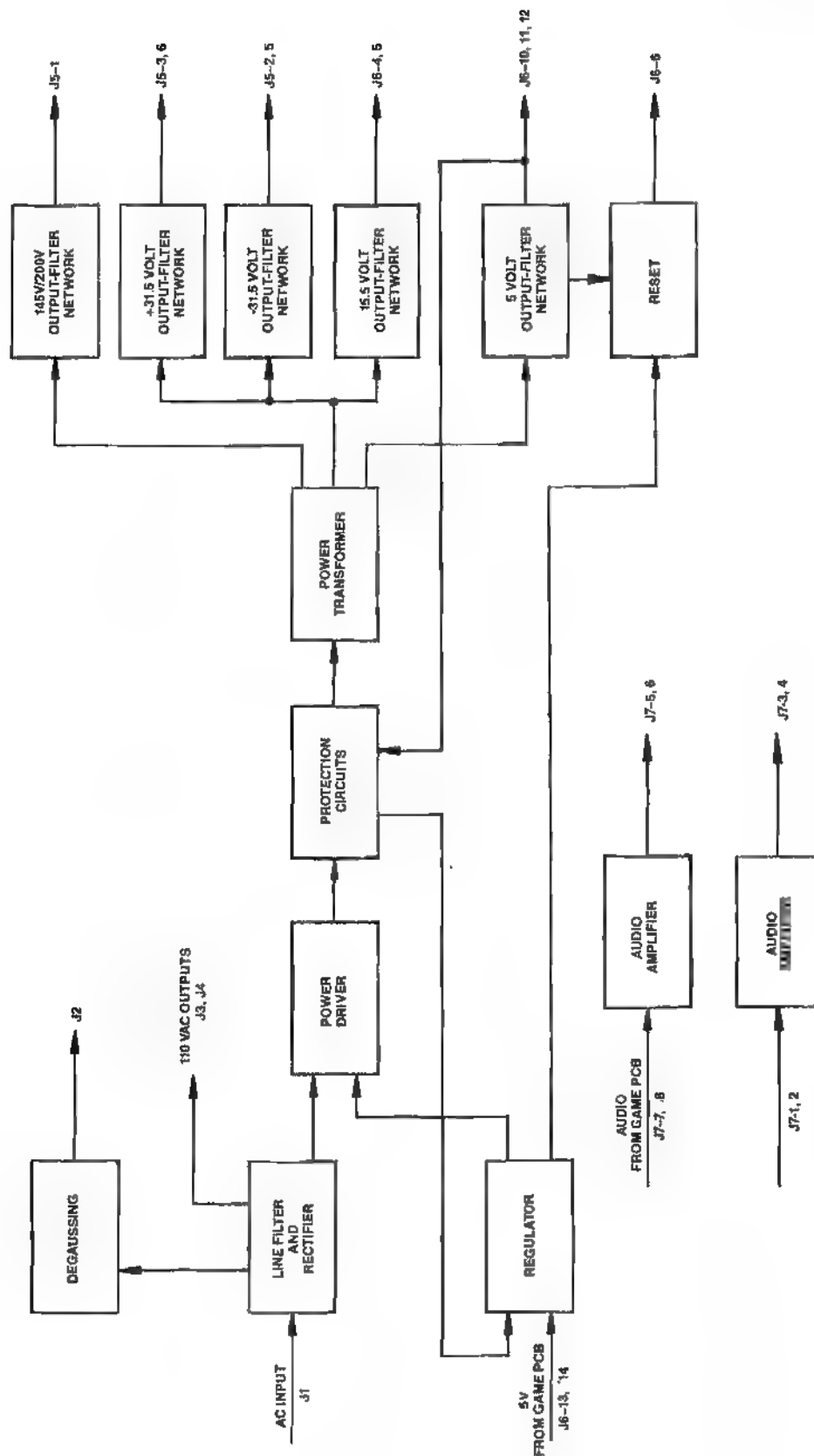


Figure 1 Block Diagram

source to turn on. The maximum voltage between gate and source is 20 volt. Since the gates of Q1 and Q2 are a very high impedance, they can be driven directly by integrated circuit U2 in the regulator stage. The fuse F5 is used to protect Q1 and Q2 and resistors R21-R24.

Transformer T2 provides opposite phasing for Q1 and Q2 so that only one is turned on during a pulse from U2. Transformer T2 also provides the required isolation between the power driver stage and the low-voltage circuits in the regulator. Transformer T2 has a turns ratio of 1:1.5:1.5 which provides +15 volt to the gates of Q1 and Q2 when they turn on. The outputs of Q1 and Q2 then go to capacitor C18 which is used to eliminate any DC bias on power transformer T4. Transformer T3 is part of the protection circuits.

Power Transformer. The power transformer T4 functions like a power transformer in a linear-type supply since the voltage of the output pulses is dependent on the turns ratios. The RC snubber network R26 and C19 provides high-frequency suppression. Note that transformer T4 is connected between transistors Q1 and Q2 in the power driver stage and C6 and C7 in the rectifier stage. If C6 and C7 were transistors, this circuit would then be a full-bridge power supply. Since only two transistors are used, this configuration is called a half-bridge power supply.

Outputs: -05 Version Only (145/200 V,  $\pm 31.5$  V, 15.5 V, and 5 V). The 5-volt and  $\pm 31.5$ -volt output stages are identical. Therefore, the 5-volt stage will be discussed here with significant differences mentioned only where necessary.

**NOTE**

-07 (U.S. line voltages): 10 A, 5 V output, 2-Channel Audio (Stereo) Power Supply for Raster Display. Components associated with  $\pm 31.5$  V are not inserted.

-17 (European line voltages): 10 A, 5 V output, 2-Channel Audio (Stereo) Power Supply for Raster Display. Components are inserted for 220 V input. Components associated with  $\pm 31.5$  V are not inserted.

Center-tapped bridge rectifier BR7 has a common-cathode output which provides a positive voltage at the output of the supply. (A common-anode output, such as the one used with BR4, would provide a negative output.) The output of BR7 is a series of positive pulses about 8 volt in amplitude with respect to ground. The LC network L7 and C41 filters the positive pulses to provide a DC

output. The LC time constant of this circuit is set at less than 1000 hertz which results in an attenuation of greater than 2000 on the input pulses.

(Note that the effective frequency of these pulses is 50 kilohertz.) The LC network, L7 and C41, provide an output that is the average voltage of the input pulses. Thus, as the line voltage drops, the amplitude of the pulses will also drop. However, by increasing the width of the pulses, the average voltage will remain constant. Pulse-width modulation enables the switching power supply to regulate the output. Note that if the output impedance is high, capacitor C41 will hold the peak value of the output pulses. The 5-volt output has no minimum load on the supply. Consequently, a load must be supplied for proper operation. All other outputs from this supply (resistors R41, R46 through R51, and R81 through R84) have minimum loads. The RC networks C39 and R52, and C40 and R53 operate as snubber networks to prevent high-frequency oscillations. Resistors R54 and R55 provide feedback for regulation if the remote-sense lines are not connected.

Unlike the 5-volt output, the 15.5-volt output uses a center-tapped half-bridge rectifier circuit comprised of diodes CR10 and CR11. The combination of the half-bridge rectifier and the LC filter network L5 and C35 provide an output voltage which is half of the +31.5 volt.

The 145-volt output uses a full-bridge rectifier which requires twice the diodes of the center-tapped bridge rectifier. However, the maximum reverse voltage that each diode must withstand is the peak amplitude of the input pulses (about 350 volt). Also, the input pulses can have an additional 150-volt spike. Consequently, the peak-inverse voltage of the diodes would have to be at least 600 volt (800 volt would provide a more reasonable safety margin). A center-tapped half-bridge rectifier would have to withstand a peak-inverse voltage of about 500 volt plus the 145-volt output. Thus, the full-bridge rectifier is used for the 145-volt output.

Regulator. Integrated circuit U1 provides regulation by pulse-width modulation. The outputs from pins 11 and 14 of U1 are applied to the primary of transformer T2 which is part of the power driver stage. Diodes CR3-CR6 protect U1 from voltage spikes. Resistor R7 and capacitor C10 set the frequency of the U1 oscillator while R8 and C10 set the dead time. The operating frequency of the oscillator is approximately

$$\frac{1}{2(R7 + R8)C10}$$

Compensation network R9 and C11 prevents high-frequency oscillations. Capacitor C12 is a soft-start capacitor with charge time set for about 1-5 seconds by an internal current source. (Soft start means that the width of the pulses slowly expands until regulation is obtained.) Integrated circuit U1 has an accurate internal 5.1-volt reference which is used as the reference voltage to regulate the 5-volt output. The 5 volt is regulated at the game board by the +5-volt sense line which is connected directly to pin 1 of U1

(-IN). The 5.1-volt reference is applied to pin 2 of U1 (+IN) and sourced at pin 16. Thus, the game board logic voltage is regulated to the internal reference voltage of U1. The ground for U1 is the +5-volt sense return line from the game board. This enables sensing both the +5 volt and ground at the game board. If either or both sense lines are broken, resistors R54 and R55 provide the necessary feedback to supply 5 volt to the game board. The voltage at the game board would be inaccurate with broken sense lines; but the game would most likely function properly.

Pin 10 of U1 is the shutdown input and is connected to the collector of Q3. When held at ground, U1 will function normally. If the voltage at pin 10 exceeds 1 volt, then U1 will go into a standby mode where no output pulses are produced. As soon as the voltage at pin 10 goes to ground, U1 will resume normal operation. The input to pin 10 is part of the protection circuits covered in the following discussion.

Protection Circuits. The protection circuits, the regulator, and the reset circuits all obtain power from the 12 volt supply. This supply is comprised of transformer T1, bridge rectifier CR21-CR24, and voltage-regulator integrated circuit VR1. The separate 12-volt supply allows these circuits to operate even if the switching section is shut down. In addition, the separate 12-volt supply ensures that the switching section will start reliably. Transformer T3 is a current sensor that provides an output voltage proportional to the current through its primary. The secondary of T3 is fed to pin 6 of comparator U2. Pin 7 of U2 is set for a level that indicates an excessive input current condition. If the secondary of T3 exceeds this level, the output at pin 1 goes low which also appears at pin 5 of a second comparator stage. The second comparator inside U2 is connected to form a latch. With a low at pin 5, the output at pin 2 also goes low and will remain low until power is removed from U2. Thus, power must be removed from the supply before this second comparator resets. A low at pin 2 of the second comparator turns on transistor Q3 and illuminates light-emitting diode (LED) CR7 to indicate that the supply is shut down. The current through the collector of Q3 produces a voltage at pin 10 of regulator U1 and places U1 in standby mode. Thus, no output is generated when an excessive current condition exists in the supply.

Transistor Q4 is also part of the protection circuit. The emitter of Q4 is tied to the internal reference voltage and the base is tied to a voltage divider R25 and R27. Thus, if the 5-volt output goes too high, Q4 turns on (about 6.5 V), which also turns on Q3. This condition will also force U1 into the standby mode. Since Q4 is not a latch, power does not have to be removed to reset the latch and restore normal operation. A high 5-volt output usually indicates an underload condition, so no latching is required to protect the supply.

Reset. The reset stage provides a reset input to the game microprocessor which indicates the condition of the power supply outputs. The soft-start



voltage from pin 8 of regulator U1 is applied to pin 10 of comparator integrated circuit U2. Comparator U2 is set so that pin 13 of U2 is high when the soft-start voltage is too low to assure proper regulation. The high from pin 13 of U2 turns on transistor Q5 which produces a logic low to the game board reset circuitry. Diodes CR12 and CR13 are used to isolate the two sections of the supply reset circuitry. The 5-volt pulse train from the rectifier of the 5-volt output section is applied to pin 9 of U2. Resistors R38, R39, and diode CR15 form a voltage-divider network that establishes a 5 volt set point on pin 9 of U2. Pin 8 of U2 is tied to the internal 5-volt reference of regulator U1. The minimum input pulse is about 5.8 volt to prevent triggering comparator U2. At this point, the supply should have a hold-up time (5 volt remaining in regulation) of about 16 milliseconds. If the 5-volt pulse train amplitude becomes too low, pin 14 of U2 goes low. The clock input at pin 2 of timer integrated circuit U3 is triggered by a low. Timer U3 is set for about a 200 millisecond output (high) at pin 3. Timer U3 cannot be triggered once it is in the triggered state. However, if the input at pin 2 remains low beyond 200 milliseconds, the output will remain high. A high at pin 3 of U3 also turns on Q5 which warns the game board logic that power will be lost. (Note that the reset section is used only by the game board and does not affect the power supply.)

Audio. The audio stage(s) provide amplification for the game sounds. Games with stereo sound systems use two identical audio stages. Thus, only the stage used with all the supplies will be described here.

The input to the audio stage is a differential signal which provides good common-mode rejection of the noise induced into the cable. Capacitors C54 and C55 AC-couple the audio signal to pins 2 and 3 of operational-amplifier integrated circuit U6. Amplifier U6 is used in the differential mode. Amplifier U7 requires a dual-voltage supply to operate properly and, since only a single supply is available, the other half of U6 is used to provide a voltage that is halfway between ground and the supply voltage. This then becomes the effective ground for the audio amplifier. The audio output from pin 1 of U6 is applied through voltage-divider network R71 and R72 to pin 1 of operational-amplifier integrated circuit U7. The gain of U7 is set at 30 (the most stable operating point) by resistors R73 and R74. The audio output from pin 4 of U7 is AC-coupled through capacitor C60 to the game speaker(s). Note that the return of the speaker(s) is at -31.5 volt. The optional audio amplifier provides a speaker return at -31.5 volt for a raster supply and at ground for an X-Y supply.

## 4 TROUBLESHOOTING

### Troubleshooting Aids

Troubleshooting aids are provided throughout this manual. The following information is intended to acquaint the service technician with the portions of this document that contain useful troubleshooting information.

### Precautions

Do not troubleshoot the switching power supply until you are thoroughly familiar with all precautions described below and in Chapter 1. Failure to observe these precautions could result in serious personal injury or damage to the power supply.

- NEVER defeat the overcurrent protection circuit comprised of T3, U2, and Q3. If this circuit continues to trigger and is defeated, the power MOSFET Q1 and Q2 may be destroyed.
- When checking the circuitry connected to the line voltage ALWAYS use an isolated oscilloscope.
- If Q1 and Q2 fail, replace both transistors even if one seems to be operating properly.
- NEVER try to operate only one MOSFET Q1 or Q2.
- The 5-volt output must have at least a 1-ampere load for proper operation. If operated under no load, the supply will generate a series of very short pulses.
- A lightly overloaded condition can cause the pulse width to be very narrow and may not set comparator U2 into the latched condition.

### Circuit Description

A detailed circuit description of the switching power supply is provided in Chapter 3. Refer to this description to obtain a thorough knowledge of the operation of the supply circuitry before attempting to troubleshoot.

### Assembly and Component Locations

The illustrated parts list in Chapter 5 provides an assembly and component location illustration of the printed-circuit board (PCB).

### Schematic Diagram

A complete schematic diagram (Figure 3) of the switching power supply is included in Chapter 6 of this manual. The schematic diagram contains waveforms obtained at critical points in the circuitry.

### Performance Specifications

Performance specifications are provided in Chapter 2 which are helpful to determine if the major circuits are performing properly.

### 5 ILLUSTRATED PARTS LIST

This chapter provides information you need to order parts for your power supply. Common hardware (screws, nuts, washers, etc.) has been deleted from the parts list.

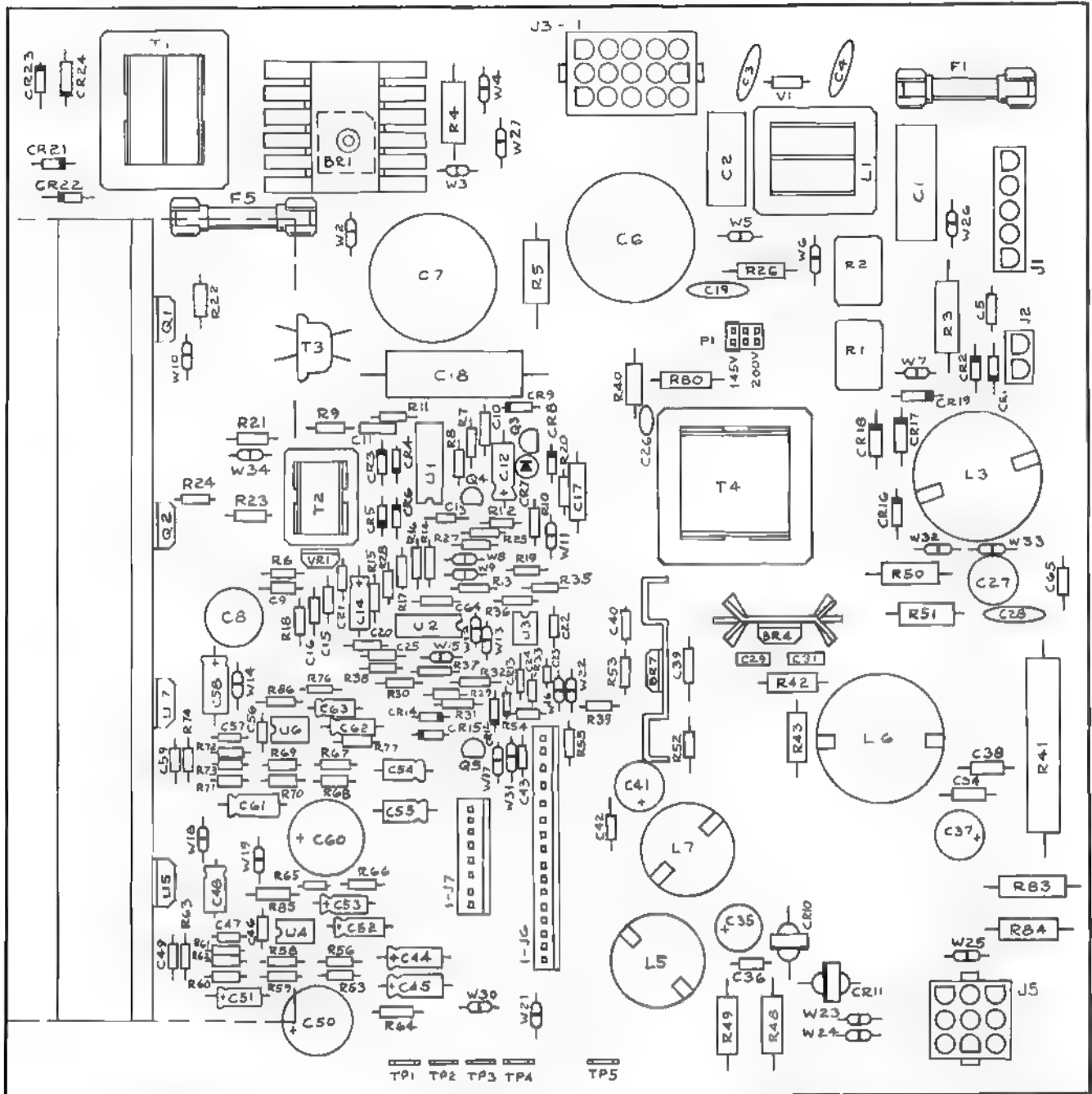
The power supply PCB parts list is arranged in alphabetical order by component. Each component subsection is arranged alphanumerically by reference designator.

Other parts lists are arranged alphanumerically by Atari part number. In these parts lists, all A-prefix numbers come first. Following these numbers in sequence evaluated up to the hyphen, namely 00- through 99-, then 000598- through approximately 201000-.

When ordering parts, please give the part number, part name, number of this manual, and serial number of your power supply. This will aid in filling your order rapidly and correctly. We hope the results will be less downtime and more profit from your game.

Atari Customer Service numbers are listed on the inside front cover of this manual.

Wherever a static-sensitive device appears in the parts list, this symbol appears: (!).



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**Figure 2 Switching Power Supply PCB Assembly**  
**A038074-07**

### Switching Power Supply Assembly Parts List

| Designator               |     | Description   | Part No.   |
|--------------------------|-----|---|------------|
| For -07 Version          |     |   |            |
| F1                       | (!) | 6.25A, 250 V, Slow Blow Fuse  | 46-2016252 |
| F5                       |     | 2.0A, 250 V, Normal Blow Fuse   | 46-2032002 |
| W2-W19                   |     | 0 $\Omega$ Resistor   | 110005-001 |
| W21-W27                  |     | 0 $\Omega$ Resistor   | 110005-001 |
| W30-W34                  |     | 0 $\Omega$ Resistor   | 110005-001 |
| For -17 Version          |     |   |            |
| F1                       | (!) | 3 A, 250 V, Slow Blow Fuse  | 46-2013002 |
| F5                       |     | 2.5A, 250 V, Normal Blow Fuse   | 46-2032002 |
| W2-W4                    |     | 0 $\Omega$ Resistor   | 110005-001 |
| W8-W19                   |     | 0 $\Omega$ Resistor   | 110005-001 |
| W21-W28                  |     | 0 $\Omega$ Resistor   | 110005-001 |
| W30-W34                  |     | 0 $\Omega$ Resistor   | 110005-001 |
| For -07 and -17 Versions |     |   |            |
| <b>Capacitors</b>        |     |   |            |
| C1, C2                   |     | 0.47 $\mu$ F, $\pm 20\%$ , 250 VAC Capacitor                              | 129001-474 |
| C3, C4                   |     | 0.0033 $\mu$ F, $\pm 20\%$ , 250 VAC Disc<br>Ceramic Capacitor            | 129000-332 |
| C5                       |     | 0.056 $\mu$ F, $\pm 20\%$ , 400 V Met/Polyester<br>Capacitor              | 121009-563 |
| C6, C7                   |     | 1000 $\mu$ F, $\pm 20\%$ , 200 V Capacitor                                | 123011-108 |
| C8                       |     | 1000 $\mu$ F, $+80\%$ , $-20\%$ , 35 V Aluminum<br>Electrolytic Capacitor | 123000-108 |
| C9                       |     | 0.1 $\mu$ F, $\pm 20\%$ , 50 V Ceramic Capacitor                          | 122002-104 |
| C10                      |     | 0.0047 $\mu$ F, $\pm 10\%$ , 63 V Metalized<br>Mylar Capacitor            | 126004-472 |
| C11                      |     | 0.1 $\mu$ F, $\pm 10\%$ , 63 V Metalized<br>Mylar Capacitor               | 126004-104 |
| C12                      |     | 100 $\mu$ F, $+80\%$ , $-20\%$ , 6.3 V Aluminum<br>Electrolytic Capacitor | 124007-107 |
| C13                      |     | 0.01 $\mu$ F, $\pm 20\%$ , 25 V Ceramic Capacitor                         | 122005-103 |
| C14                      |     | 1.0 $\mu$ F, $+80\%$ , $-20\%$ , 50 V Aluminum<br>Electrolytic Capacitor  | 24-500105  |
| C15, C16                 |     | 0.1 $\mu$ F, $\pm 20\%$ , 50 V Ceramic Capacitor                          | 122002-104 |

\*\* continued on next page \*\*

**Switching Power Supply Assembly  
Parts List, continued**

| Designator | Description  | Part No.   |
|------------|--|------------|
| C17        | 0.015 $\mu$ F, $\pm 10\%$ , 50 V, Axial-Lead<br>Ceramic Capacitor        | 122015-153 |
| C18        | 3.0 $\mu$ F, $\pm 20\%$ , 200 V Polypropylene<br>Capacitor               | 125002-305 |
| C19        | 0.005 $\mu$ F, $\pm 20\%$ , 500 V Ceramic Capacitor                      | 122000-502 |
| C20-C22    | 0.1 $\mu$ F, $\pm 20\%$ , 50 V Ceramic Capacitor                         | 122002-104 |
| C23        | 0.01 $\mu$ F, $\pm 20\%$ , 25 V Ceramic Capacitor                        | 122005-103 |
| C24, C25   | 0.1 $\mu$ F, $\pm 20\%$ , 50 V Ceramic Capacitor                         | 122002-104 |
| C26        | 470 pF, $\pm 20\%$ , 1 kV Ceramic Disc Capacitor                         | 120004-471 |
| C27        | 10 $\mu$ F, $+80\%$ , $-20\%$ , 250 V Aluminum<br>Electrolytic Capacitor | 123002-106 |
| C28        | 0.005 $\mu$ F, $\pm 20\%$ , 500 V Ceramic Capacitor                      | 120001-502 |
| C35        | 22 $\mu$ F, $+80\%$ , $-20\%$ , 25 V Low ESR Capacitor                   | 123016-226 |
| C36        | 0.1 $\mu$ F, $\pm 20\%$ , 50 V Ceramic Capacitor                         | 122002-104 |
| C37        | 100 $\mu$ F, $+80\%$ , $-20\%$ , 50 V Low ESR Capacitor                  | 123014-107 |
| C38-C40    | 0.1 $\mu$ F, $\pm 20\%$ , 50 V Ceramic Capacitor                         | 122002-104 |
| C41        | 1000 $\mu$ F, $+80\%$ , $-20\%$ , 6.3 V Low ESR Capacitor                | 123010-102 |
| C42, C43   | 0.1 $\mu$ F, $\pm 20\%$ , 50 V Ceramic Capacitor                         | 122002-104 |
| C44, C45   | 10 $\mu$ F, $+80\%$ , $-20\%$ , 25 V Aluminum<br>Electrolytic Capacitor  | 24-250106  |
| C46        | 0.1 $\mu$ F, $+80\%$ , $-20\%$ , 50 V Ceramic Capacitor                  | 122002-104 |
| C47        | 0.022 $\mu$ F, $\pm 10\%$ , 50 V X7R Ceramic Capacitor                   | 122015-223 |
| C48        | 47 $\mu$ F, 50 V Aluminum Electrolytic<br>Axial-Lead Capacitor           | 124001-470 |
| C49        | 100 pF, $\pm 10\%$ , NPO Ceramic Capacitor                               | 122016-101 |
| C50        | 470 $\mu$ F, $+80\%$ , $-20\%$ , 25 V Low ESR Capacitor                  | 123016-477 |
| C51, C52   | 1.0 $\mu$ F, $+80\%$ , $-20\%$ , 50 V Aluminum<br>Electrolytic Capacitor | 24-500105  |
| C53-C55    | 10 $\mu$ F, $+80\%$ , $-20\%$ , 25 V Aluminum<br>Electrolytic Capacitor  | 24-250106  |
| C56        | 0.1 $\mu$ F, $\pm 20\%$ , 50 V Ceramic Capacitor                         | 122002-104 |
| C57        | 0.022 $\mu$ F, $\pm 10\%$ , 50 V X7R Ceramic Capacitor                   | 122015-223 |
| C58        | 47 $\mu$ F, 50 V Aluminum Electrolytic<br>Axial-Lead Capacitor           | 124001-470 |
| C59        | 100 pF, $\pm 10\%$ , NPO Ceramic Capacitor                               | 122016-101 |
| C60        | 470 $\mu$ F, $+80\%$ , $-20\%$ , 25 V Low ESR Capacitor                  | 123016-477 |

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**Switching Power Supply Assembly  
Parts List, continued**

| Designator | Description   | Part No.   |
|------------|---|------------|
| C61, C62   | 1.0 $\mu$ F, +80%, -20%, 50 V Aluminum Electrolytic Capacitor | 24-500105  |
| C63        | 10 $\mu$ F, +80%, -20%, 25 V Aluminum Electrolytic Capacitor  | 24-250106  |
| C64, C65   | 0.1 $\mu$ F, +80%, -20%, 50 V Ceramic Capacitor               | 122002-104 |

**Connectors**

|    |                             |            |
|----|-----------------------------|------------|
| J1 | 5-Contact Header Connector  | 179069-005 |
| J2 | 2-Contact Header Connector  | 179069-002 |
| J3 | 15-Contact Header Connector | 179069-015 |
| J5 | 9-Contact Header Connector  | 179069-009 |
| J6 | 16-Contact Header Connector | 179014-016 |
| J7 | 8-Contact Header Connector  | 179014-008 |

**Diodes**

|          |   |  |
|----------|---|--|
| BR1      | (!) Bridge Rectifier Assembly--includes<br>Type TO-220 Heatsink<br>6 A, 600 V Bridge Rectifier<br>#6-32 x 1/2-Inch Pan-Head Screw<br>#6-32 Nut/Washer Assembly  | A039582-01<br>178063-003<br>131022-001<br>72-1608S<br>75-99516 |
| BR4      | Power Diode Assembly (Acceptable substitute is part no. A039581-03)--includes<br>12 A, 150 V Fast Recovery Rectifier<br>Type-TO-202 Black Aluminum Heatsink<br>#4-40 x 3/8-Inch Pan-Head Screw<br>#4-40 Nut/Washer Assembly | A041812-03<br>131023-001<br>178162-001<br>72-1406S<br>75-99514 |
| BR7      | FIREFOX* Power Diode Assembly--includes<br>16 A, 35 V Dual Schottky Diode<br>Black Aluminum Heatsink<br>#6-32 x 3/8-Inch Pan-Head Screw<br>#6-32 Nut/Washer Assembly  | A041813-01<br>131034-001<br>178161-001<br>72-1606S<br>75-99516 |
| CR1, CR2 | Type-1N4001, 50 V Rectifier Diode   | 31-1N4001  |
| CR3-CR6  | Type 1N914, 100 V, 10 mA Switching Diode  | 31-1N914   |
| CR7      | Red Light-Emitting Diode  | 38-MV5053  |
| CR8-CR9  | Type 1N914, 100 V, 10 mA Switching Diode  | 31-1N914   |

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**Switching Power Supply Assembly  
Parts List, continued**

| Designator | Description  | Part No.   |
|------------|--|------------|
| CR10, CR11 | 150 V, 5 Amp Fast Recovery Diode                                       | 131019-001 |
| CR12-CR15  | Type 1N914, 100 V, 10 mA Switching Diode                               | 31-1N914   |
| CR16-CR19  | Type-1N4947, 1.0 Amp, 800 V Fast Recovery,<br>Recovery Rectifier Diode | 131028-001 |
| CR21-CR24  | Type-1N4001, 50 V Rectifier Diode                                      | 31-1N4001  |

**Inductors**

|    |                          |            |
|----|--------------------------|------------|
| L1 | Line Filter              | 140000-001 |
| L3 | 20 mH, 0.5A Inductor     | 141015-001 |
| L5 | 2 $\mu$ H, 1.4A Inductor | 141013-001 |
| L6 | 500 $\mu$ H, 5A Inductor | 141014-001 |
| L7 | 65 $\mu$ H, 8A Inductor  | 141012-001 |
| T3 | Current Sense Inductor   | 141006-001 |

**Integrated Circuits**

|     |  |            |
|-----|--|------------|
| U1  | Pulse Width Modulator Integrated Circuit                     | 137302-001 |
| U2  | Type-LM339 Volt. Comparator Integrated<br>Circuit            | 37-LM339   |
| U3  | Type-555 Timer Integrated Circuit                            | 37-555     |
| U4  | (1) Type-TL082 Dual Op. Amp. Integrated Circuit              | 37-TL082CP |
| U6  | (1) Type-TL082 Dual Op. Amp. Integrated Circuit              | 37-TL082CP |
| VR1 | Type-7812, 1 Amp, 12 V Fixed Regulator<br>Integrated Circuit | 37-7812    |

**Resistors**

|        |   |            |
|--------|---|------------|
| R1     | Positive Temperature Coefficient Resistor   | 110021-101 |
| R2     | Positive Temperature Coefficient Resistor   | 110017-101 |
| R3     | 22 $\Omega$ , $\pm 5\%$ , 5 W Resistor      | 116001-220 |
| R4, R5 | 22 k $\Omega$ , $\pm 5\%$ , 2 W Resistor    | 110010-223 |
| R6     | 4.7 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor | 110000-472 |
| R7     | 6.2 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor | 110000-622 |
| R8     | 91 $\Omega$ , $\pm 5\%$ , 1/4 W Resistor    | 110000-910 |
| R9     | 2.2 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor | 110000-222 |

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**Switching Power Supply Assembly  
Parts List, continued**

| Designator | Description                                 | Part No.   |
|------------|---|------------|
| R10        | 470 $\Omega$ , $\pm 5\%$ , 1/4 W Resistor   | 110000-471 |
| R11        | 1 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor   | 110000-102 |
| R12        | 4.7 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor | 110000-472 |
| R13, R14   | 47 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor  | 110000-473 |
| R15, R16   | 100 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor | 110000-104 |
| R17        | 39 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor  | 110000-393 |
| R18        | 100 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor | 110000-104 |
| R19        | 10 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor  | 110000-103 |
| R20        | 51 $\Omega$ , $\pm 5\%$ , 1/4 W Resistor    | 110000-510 |
| R21        | 220 $\Omega$ , $\pm 5\%$ , 1/4 W Resistor   | 110000-221 |
| R22        | 1.2 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor | 110000-122 |
| R23        | 220 $\Omega$ , $\pm 5\%$ , 1/4 W Resistor   | 110000-221 |
| R24        | 1.2 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor | 110000-122 |
| R25        | 10 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor  | 110000-103 |
| R26        | 3.3 $\Omega$ , $\pm 5\%$ , 1 W Resistor     | 110009-033 |
| R27        | 3.3 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor | 110000-332 |
| R28        | 47 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor  | 110000-473 |
| R29        | 68 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor  | 110000-683 |
| R30        | 27 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor  | 110000-273 |
| R31, R32   | 10 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor  | 110000-103 |
| R33        | 100 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor | 110000-104 |
| R34        | 22 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor  | 110000-223 |
| R35        | 1.8 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor | 110000-185 |
| R36        | 10 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor  | 110000-103 |
| R37        | 47 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor  | 110000-473 |
| R38        | 1.5 k $\Omega$ , $\pm 1\%$ , 1/4 W Resistor | 110000-152 |
| R39        | 267 $\Omega$ , $\pm 1\%$ , 1/4 W Resistor   | 110000-261 |
| R40        | 330 $\Omega$ , $\pm 5\%$ , 2 W Resistor     | 110010-331 |
| R41        | 7.5 k $\Omega$ , $\pm 10\%$ , 10 W Resistor | 116000-752 |
| R42, R43   | 27 $\Omega$ , $\pm 5\%$ , 2 W Resistor      | 110010-270 |
| R48, R49   | 330 $\Omega$ , $\pm 5\%$ , 2 W Resistor     | 110010-331 |
| R50, R51   | 820 $\Omega$ , $\pm 5\%$ , 2 W Resistor     | 110010-821 |
| R52, R53   | 3.9 $\Omega$ , $\pm 5\%$ , 1/4 W Resistor   | 110000-039 |
| R54, R55   | 10 $\Omega$ , $\pm 5\%$ , 1/4 W Resistor    | 110000-100 |
| R56, R57   | 2.4 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor | 110000-242 |
| R58, R59   | 4.7 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor | 110000-472 |

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**Switching Power Supply Assembly  
Parts List, continued**

| Designator           | Description                                 | Part No.   |
|----------------------|---|------------|
| R60                  | 2.2 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor | 110000-222 |
| R61                  | 390 $\Omega$ , $\pm 5\%$ , 1/4 W Resistor   | 110000-391 |
| R62                  | 3.3 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor | 110000-332 |
| R63                  | 100 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor | 110000-104 |
| R64                  | 1.0 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor | 110000-010 |
| R65, R66             | 22 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor  | 110000-223 |
| R67, R68             | 2.4 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor | 110000-242 |
| R69, R70             | 4.7 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor | 110000-472 |
| R71                  | 2.2 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor | 110000-222 |
| R72                  | 390 $\Omega$ , $\pm 5\%$ , 1/4 W Resistor   | 110000-391 |
| R73                  | 3.3 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor | 110000-332 |
| R74                  | 100 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor | 110000-104 |
| R75                  | 1.0 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor | 110000-010 |
| R76, R77             | 22 k $\Omega$ , $\pm 5\%$ , 1/4 W Resistor  | 110000-223 |
| R80                  | 330 $\Omega$ , $\pm 5\%$ , 2 W Resistor     | 110010-331 |
| R83, R84             | 820 $\Omega$ , $\pm 5\%$ , 2 W Resistor     | 110010-821 |
| R85, R86             | 51 $\Omega$ , $\pm 5\%$ , 1/4 W Resistor    | 110000-510 |
| V1                   | 100 Amp, 264 V Variable Resistor            | 110019-001 |
| <b>Transistors</b>   |   |            |
| Q3                   | 40 V PNP Transistor                         | 33-2N3906  |
| Q4, Q5               | 350 mW, 60 V NPN Transistor                 | 34-2N3904  |
| <b>Miscellaneous</b> |   |            |
|                      | Fuse Clips                                  | 179050-002 |
|                      | 6-Circuit Connector Header                  | 179177-006 |
|                      | 2-Circuit Receptacle Connector              | 179178-002 |
| T1                   | Power Transformer                           | 142036-002 |
| T2                   | Driver Transformer                          | 142034-001 |
| T3                   | Current Sense Inductor Transformer          | 141006-001 |
| T4                   | Power Transformer                           | 142033-001 |
| TP1-TP5              | Fast-On Terminal Tab                        | 179051-002 |
| Q1, Q2               | (!) Heatsink Assembly —includes             | A039580-02 |
| U5, U7               | Switching Power Supply Heatsink             | 039561-01  |
|                      | Type-TO22, 40 V, MOS FET Transistor         | 133016-002 |
|                      | Audio Amp Integrated Circuit                | 137301-001 |
|                      | Type-TO-220 Mica Insulator                  | 178109-001 |
|                      | #6-32 Nut/Washer Assembly                   | 75-99516   |



## 6 SCHEMATIC DIAGRAMS

Complete schematic diagrams of the switching power supply, including the audio amplifiers, are provided in this chapter. Component designations and their electrical values are included on the schematic diagrams.

The shaded areas of the switching power supply schematic indicate components whose values are of special significance to product safety. Should any component in the shaded areas need to be replaced, use only the value given in the parts lists. Do not deviate from the resistance, wattage, and voltage values shown.

Waveform illustrations are provided on the schematic as an aid to troubleshooting the switching power supply. The eight waveforms are obtained across the test points indicated by the corresponding numbers on the schematic.

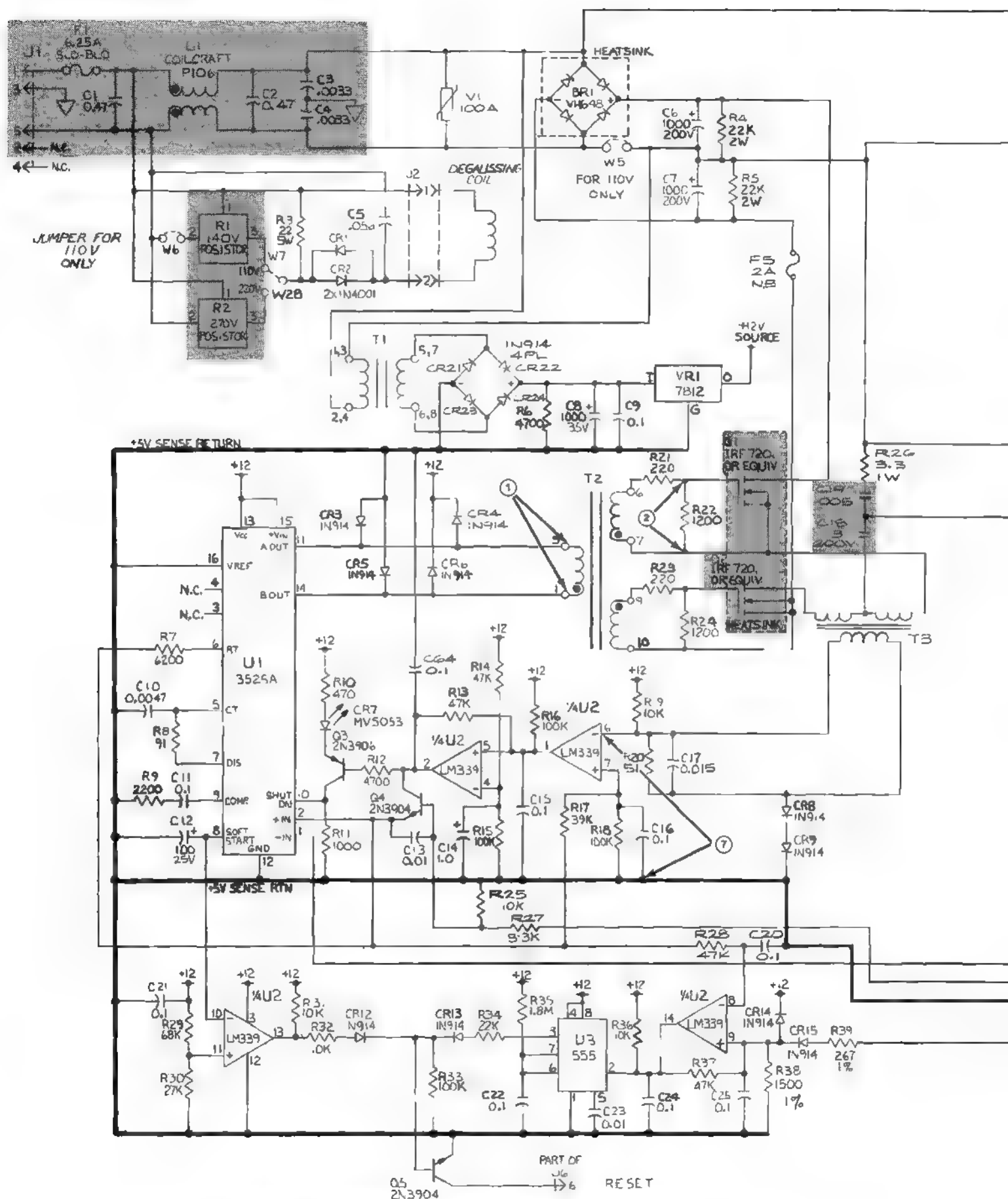
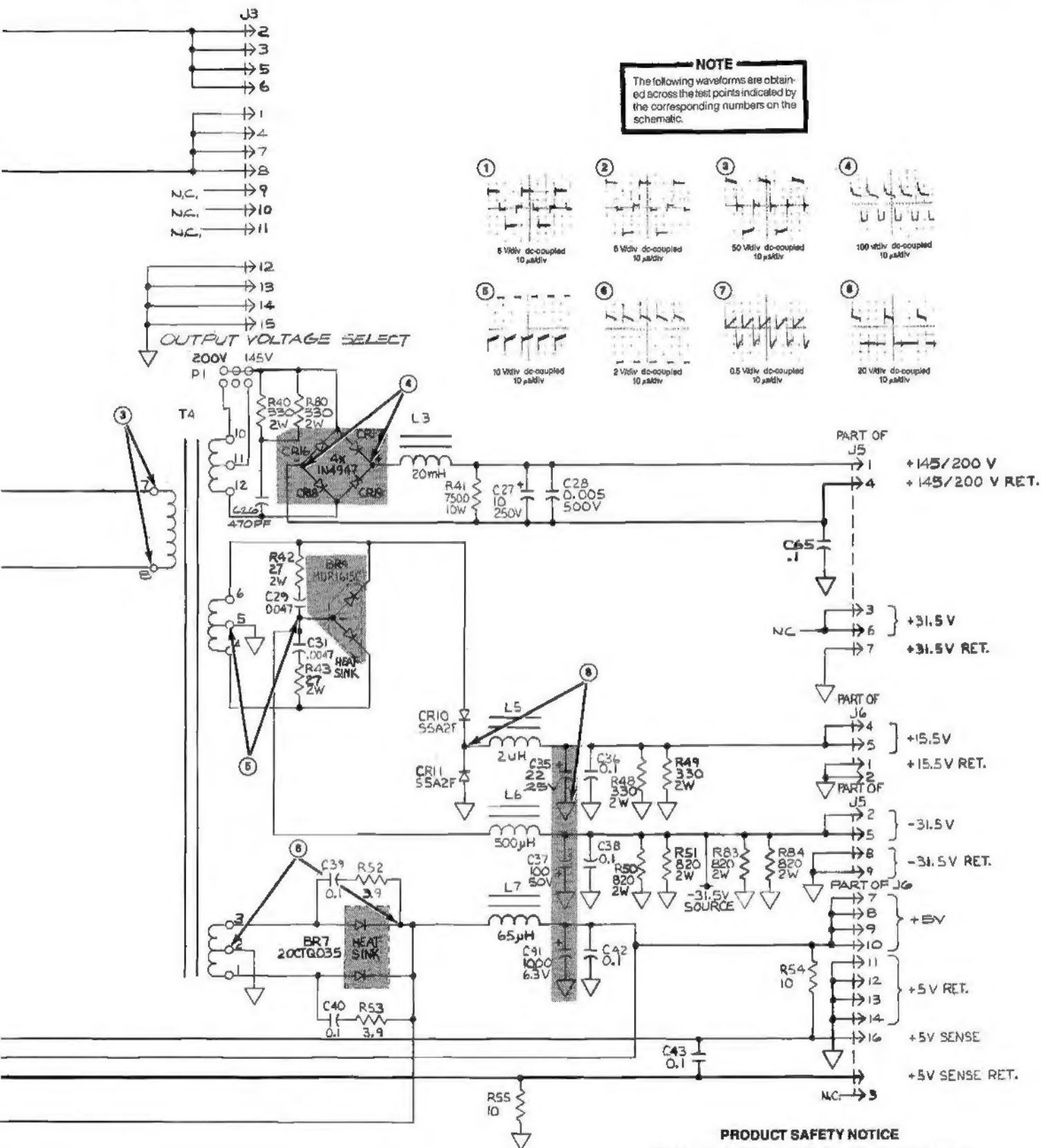


Figure 3 Switching Power Supply Schematic Diagram

038074-07



**Figure 3 Switching Power Supply Schematic Diagram, continued**  
038074-07

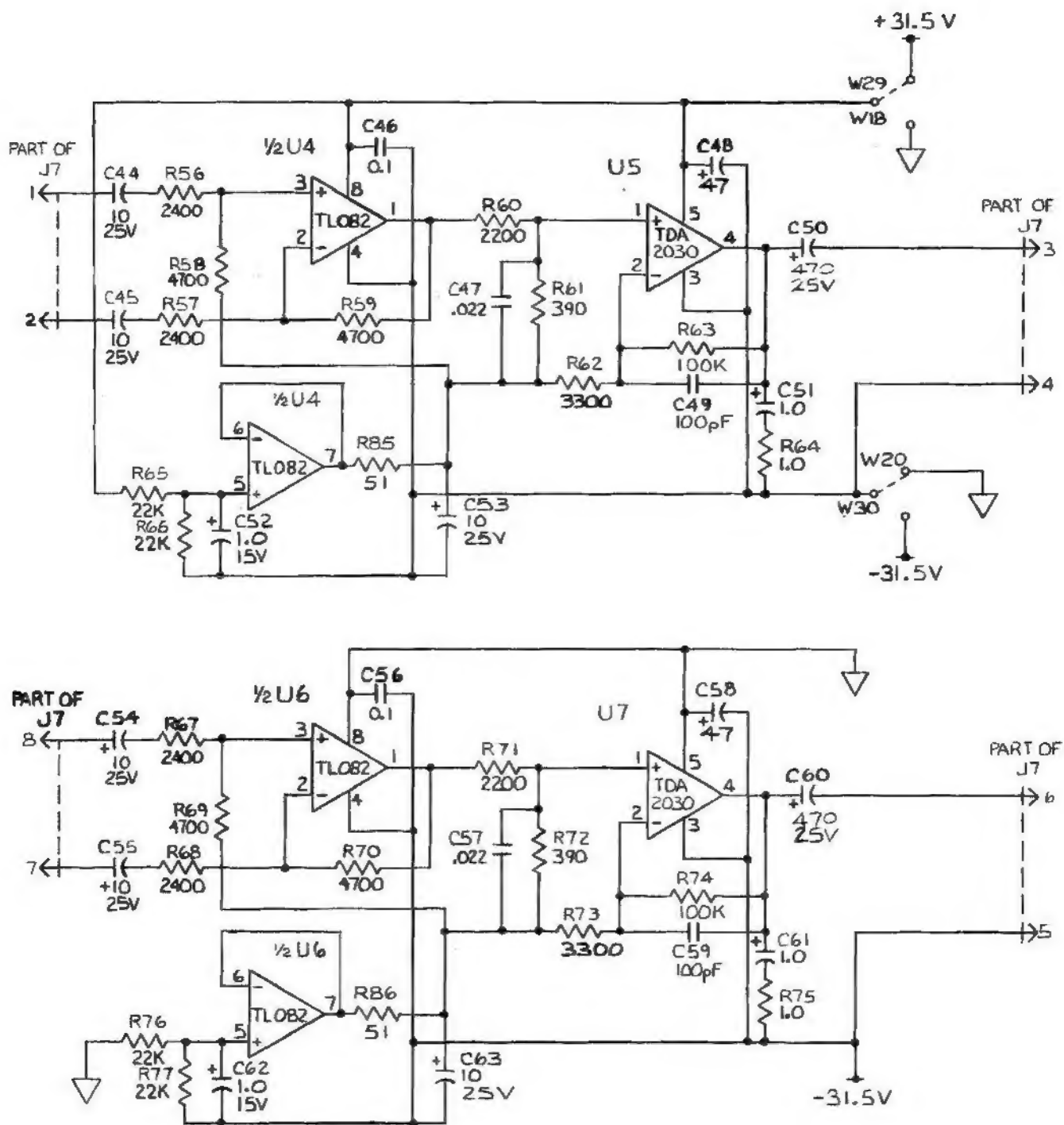


Figure 4 Audio Amplifier Schematic Diagram



# Warranty

Seller warrants that its printed-circuit boards and parts thereon are free from defects in material and workmanship under normal use and service for a period of ninety (90) days from date of shipment. Seller warrants that its video displays (in games supplied with displays) are free from defects in material and workmanship under normal use and service for a period of thirty (30) days from date of shipment. None of the Seller's other products or parts thereof are warranted.

If the products described in this manual fail to conform to this warranty, Seller's sole liability shall be, at its option, to repair, replace, or credit Buyer's account for such products which are returned to Seller during said warranty period, provided:

- (a) Seller is promptly notified in writing upon discovery by Buyer that said products are defective;
- (b) Such products are returned prepaid to Seller's plant; and
- (c) Seller's examination of said products discloses to Seller's satisfaction that such alleged defects existed and were not caused by accident, misuse, neglect, alteration, improper repair, installation, or improper testing.

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